FROZEN FOODS

Margins, Costs, and Returns in Relation to Display Space

ERS-235

U. S. DEPARTMENT OF AGRICULTURE-ECONOMIC RESEARCH SERVICE

PREFACE

The purpose of this study was to determine the relation of display space for frozen foods to their costs, margins, and returns. It is one of a number of studies made by the Economic Research Service to evaluate the retail pricing and merchandising practices for farm products and to point up opportunities for expanding markets.

Although the fieldwork for the report was conducted in 1961, changes in frozen food retailing since that time have not been great enough to impair the validity or timeliness of the findings.

ACKNOWLEDGMENTS

Charles Crossed, Jr., planned the overall study and collected the economic cost data. Donald Moore collected and tabulated the experimental test data under the supervision of Dr. Theodore W. Leed, University of Massachusetts. The cooperation of Milton Segel, Vice President, Patrick Murphy, Controller, Peter Di Gennaro, Assistant Controller, David Ginsberg, Head Buyer, and Charles Regan, Dairy Buyer, all of the Elm Farm Food Company, in permitting us to use their records and facilities for the study is also recognized. The K.M.S. Bruce Company, Point Pleasant, Pa., provided part of the expense data.

This study was conducted under the general supervision of Robert Frye and Dr. William Hoofnagle, Chief, Market Development Branch, Marketing Economics Division, Economic Research Service.

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July 1965

SUMMARY

The need for a reappraisal of the margin structure and pricing policies for frozen foods was indicated by the performance of 8 frozen food departments of a New England food chain. Since returns per square foot of space for some of the 13 product groups were double those of other groups, special attention should be given to improving the space utilized by the product groups within the department. Such a reappraisal is necessary if margins and space allotments are to reflect their long-run cost structure, and maximum sales potentials are to be achieved for all groups in the frozen food department.

Neither the size of the frozen food department, as measured in sales volume, nor the square feet of selling area appeared to have much effect upon net profit as a percentage of department sales. Net profit of the frozen food department (3.9 percent of sales) was about double that for the average store in the food chain. High gross margins (25.6 percent of sales) and low variable costs (3.7 percent of sales) were primarily responsible for the high profit of this department. High margins and low variable costs, however, were partially offset by high fixed department costs (10.2 percent of sales). Turnover for the frozen food department (measured in weekly sales per square foot of selling area) was a fifth below that for the entire store, or $2.67 compared with $3.36. The relatively low turnover indicates the need for improving the space of frozen foods.

Three product groups (drinks, vegetables, and dinners) accounted for over half the sales of frozen food during an 8-week experimental test. Gross margins by groups ranged from 18.8 percent for meat pies to 28.9 percent for fish. But, turnover was the predominant factor affecting returns. A negative correlation between margins and turnover for product groups did, however, indicate that turnover was an important consideration in the pricing process. Turnover explained about 38 percent of the differences in gross margins among groups.

Returns to fixed costs varied widely by product group. Weekly returns per square foot of display space were $2.12 for the department, but ranged from only $1.17 for bakery products to $3.61 for orange juice. These costs again pointed toward the need for better space practices.

Both average and marginal returns ratios from the experimental test are reported. Marginal ratios are much better guides than average ratios for evaluating performance and space utilization since marginal ratios indicate the response from changing space allotments. Peas, for example, had average sales per square foot of $10.41 but marginal sales per square foot of only $2.60. Through the use of marginal ratios and the further application of experimental methods reported in this study, substantial improvements could be made in space allocation of frozen foods.

FROZEN FOODS
MARGINS, COSTS, AND RETURNS IN RELATION TO DISPLAY SPACE

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INTRODUCTION

Sales of frozen food (including frozen meat and fish but not ice cream) rose rapidly after World War II. In 1958, they accounted for 4.3 percent of total sales of retail food stores. 1/ Despite forecasts and projections for similar increases, the rise in frozen food sales has tapered off substantially since then. In 1962, these sales accounted for 4.6 percent of total sales of retail food stores. One possible cause for this leveling out may be the retail merchandising and pricing practices for these products.

The purpose of this report is to evaluate retail pricing and merchandising practices for frozen foods by analyzing:

(1) The sales and profit response from altering the amount of display space for the frozen food department and major product groups within it.

(2) The costs, margins, and returns for major commodity groups of frozen food products.

Through such information, public officials, farmers, and all segments of the frozen food industry will have a better understanding of the retail marketing functions. Distributors especially may find the principles presented in this report helpful in guiding their own pricing and merchandising policies.

PROCEDURE

This study was conducted in 8 frozen food departments of the same retail chain located in New England. By selecting all departments from one firm, differences among stores in pricing, merchandising, and feature promotions were minimized. This made it possible to determine those variables having the greatest impact on the performance of frozen food products. Though these results may not apply specifically to other frozen food departments, they should approximate the types of general economic relationships present in most of them.

1/ The Super Market Industry Speaks (1963). Supermarket Institute, Chicago, Ill., p. 22.

The study consists of two parts. The first part measures the performance of the frozen food department with company records. Its purpose is to ascertain the effect of store size and to determine which factors have the largest impact upon departmental performance. The appropriateness and usefulness of the various performance measures are also discussed.

The second part of the study reports the findings of an experimental test to determine the performance of 13 product groups during an 8-week period. (See appendix for details.) While all other factors were held constant through a combination of experimental and statistical controls, the sales response to changes in the display space of frozen foods was measured. This net sales response is the marginal sales per square foot of display space and reflects the change in sales directly attributable to a change in display space of 1 square foot. It can be used to evaluate the performance of product groups and as a guide for reallocating space.

RESULTS

Description of the Departments

The 8 departments were divided into a high- and a low-turnover group in order to measure the effect of turnover upon performance (table 1). The high-turnover group consisted of departments in stores having weekly sales over $40,000 and weekly sales per square foot of selling area over $4. Stores in the low-turnover group had weekly sales between $20,000 and $40,000 and weekly sales per square foot of selling area between $2 and $3.

Store size, measured in terms of selling area, averaged 12,720 square feet and varied little among the stores with one notable exception, store 6 in the low-turnover group. This store had a considerably larger selling area (18,860 square feet) than any other store in either group and was responsible for the higher average size for the low group (13,200 square feet) than that for the high group (12,240 square feet).

Sales of frozen food accounted for only 3.5 percent of store sales but required 4.4 percent of the selling area (table 1). Since sales of the frozen food department were low relative to occupied space, sales per square foot for the total store ($3.36) were higher than that for the frozen food department ($2.67). This relationship was consistent in all stores except number 7, in which the percentages of sales and sales per square foot were the same for both the store and department.

Low sales per square foot for the frozen food department indicated that its turnover was lower than the store average. It also emphasized the need for improving space management in this department that has one of the highest costs of display space in the store. Unless better techniques and practices are developed for improving turnover, margins somewhat higher than the store average will be required for the frozen food department.

Table 1.--Sales, selling area, and space productivity for 8 frozen food departments of 1 firm, New England, 1961

Store group and number	Sales			Area		Sales per square foot per week	
	Average weekly for store	Average weekly for frozen food	Frozen food sales as percent of total	Total selling area 1/	Frozen food selling area as percent of total 2/	Total selling area	Frozen food selling area
	Dollars	Dollars	Percent	Sq. feet	Percent	Dollars	Dollars
High-turnover group:							
Store 1	60,947	1,954	3.2	13,500	4.5	4.51	3.25
Store 2	54,578	1,744	3.2	13,500	4.2	4.04	3.04
Store 3	49,577	1,704	3.4	11,970	4.4	4.14	3.25
Store 4	40,389	1,472	3.6	10,000	4.8	4.04	3.05
Average	51,374	1,719	3.4	12,240	4.5	4.18	3.15
Low-turnover group:							
Store 5	39,406	1,339	3.4	13,290	4.7	2.97	2.12
Store 6	38,980	1,663	4.3	18,860	5.3	2.07	1.67
Store 7	28,059	1,070	3.8	10,120	3.8	2.77	2.78
Store 8	24,755	777	3.1	10,528	3.5	2.35	2.13
Average	32,800	1,212	3.6	13,200	4.3	2.54	2.18
Average (all stores)	42,085	1,465	3.5	12,720	4.4	3.36	2.67

1/ Total selling area includes checkout and front office area.
2/ Selling area for frozen foods includes display space and half an aisle.

Performance of the Total Department

Accounting net profit for the frozen food department (3.9 percent of sales) was about double that of the store net profit for the food chains in the NAFC-Cornell Study (table 2). 2/ High gross margins (25.6 percent of sales) and low variable costs (3.7 percent of sales) were primarily responsible for the high profit performance of the frozen food department. 3/ These high margins and low variable costs were partly offset by high fixed costs (10.2 percent of sales) and other allocated expenses (7.8 percent of sales).

Net profits varied widely, ranging from 5.9 percent of department sales in store 7 to 1.7 percent in store 8. However, neither size of department, as measured in volume of sales nor square feet of selling area appeared to have much effect on net profits. Rather, high gross margins from a favorable sales mix and lower than average fixed costs were the principal factors responsible for high net profits. The importance of these factors on individual store performance can be most easily seen by examining their relationships for stores 3, 6, 7, and 8 (table 2).

Direct department profit averaged 11.7 percent of sales, ranging from 10.1 percent of sales in store 6 to 13.1 percent of sales in store 3. It is a more appropriate criterion than accounting net profit for evaluating the long-run performance of the frozen food department relative to the other departments in a retail store. By omitting other allocated expenses, direct departmental profit focuses only upon those costs that can be influenced by changes at the retail level. Since expense items--such as accounting and other general office expenses--have to be incurred regardless of the amount of display space devoted to frozen foods, they have no direct bearing upon the performance level of an individual department.

Returns to fixed costs averaged 21.9 percent of sales, ranging from 20.8 percent in store 6 to 23.4 percent in store 7. Since variable costs were the same percentage of store sales (3.7 percent) for all stores, all the variation in returns to fixed costs was determined by gross margins which averaged 25.6 percent of sales. 4/ For short-run pricing and promotion decisions, returns to fixed costs are the most appropriate criterion for evaluating performance. Inclusion of fixed department costs for analyzing the short-run performance or for determining pricing or space-management policies is unrealistic, since the total amount of these costs is unaffected by any corrective action that might be taken. For example, fixed costs for the frozen food department may be altered by changing its display space before a store is built. After the store

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2/ The medium net profit before income taxes for 52 food chains during the 1962-63 fiscal year was 1.9 percent of sales. See: Results of Food Chains, 1962-63. National Association of Food Chains, Washington, D.C.

3/ Reference listed above. The median gross margin for the total store in 1962-63 NAFC study was 20.6 percent of sales.

4/ Variable costs consisted of trading stamps (2.0 percent of sales) and labor (1.7 percent of sales). Variable labor costs were obtained from time study requirements for pricing and stocking (table 7) and the case movement by product group during the test period in all stores. All other labor reported for the department was included as a fixed department cost.

Table 2.--Profits, costs, and returns for 8 frozen food departments, New England, 1961

Item	Unit	All stores	Store 1	2	3	4	5	6	7	8
Average weekly sales	Dol.	1,465	1,954	1,744	1,704	1,472	1,339	1,663	1,070	777
Display area	Sq. ft.	570	602	574	524	483	630	994	385	364
Percentage of sales:										
Gross margin 1/	Pct.	25.6	25.5	25.3	25.6	25.9	25.9	24.5	27.1	25.4
Variable costs 2/	Pct.	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Returns to fixed costs	Pct.	21.9	21.8	21.6	21.9	22.2	21.8	20.8	23.4	21.7
Fixed department costs:										
Labor	Pct.	2.0	1.4	1.5	1.6	2.2	1.8	1.7	2.2	3.2
Rent	Pct.	2.9	3.3	3.0	3.0	3.0	3.2	2.9	2.4	2.6
Power	Pct.	2.3	2.2	2.5	1.8	2.1	2.5	2.6	2.1	2.7
Depreciation & maintenance	Pct.	3.0	2.8	3.3	2.4	2.2	3.7	3.4	3.3	3.0
Total	Pct.	10.2	10.2	10.2	8.7	9.5	11.2	10.7	9.9	11.5
Direct departmental profit	Pct.	11.7	11.6	11.4	13.1	12.7	10.6	10.1	13.4	10.2
Other allocated expenses	Pct.	7.8	7.2	7.5	7.5	7.8	7.5	8.2	7.6	8.5
Accounting net profit	Pct.	3.9	4.4	3.9	5.6	4.9	3.1	1.9	5.8	1.7

1/ Includes warehouse and delivery charges and adjusted for advertising and promotional allowances.
2/ Consists of trading stamps (2.00 percent of sales) and variable labor costs (1.70 percent of sales).

has been built, however, these fixed costs become sunk as it is not usually feasible to alter display space in an existing store without remodeling it. Inclusion of these costs even as a constant percentage of sales, can be very misleading. Sometimes it gives the impression that out-of-pocket losses are being incurred when they are not.

In terms of overall performance, the frozen food department appeared to be profitable. This was especially true in the short-run, since frozen foods had high margins and low variable costs. Though this was partly offset in the long-run by high fixed costs and low average sales per square foot of selling area, frozen foods were about twice as profitable as the store average.

Performance of Product Group

Product group performance was measured for 13 separate product groups during the experimental test. Since the performance of product groups is a short-run comparison, no attempt was made to allocate fixed department costs to product groups. Since the amount of space devoted to a product group is likely to affect its sales, allowances for space differences are required if the performance of individual items or product groups is to be evaluated on a comparable basis. Through performance ratios, such as sales or returns per square foot of display space, meaningful evaluations of product group performance can be obtained.

SALES, MARGINS, AND TURNOVER

Drinks (27.6 percent of sales), vegetables (15.4 percent of sales), and dinners (9.9 percent of sales) accounted for over 50 percent of sales in the frozen food department (table 3). Despite the concentration of sales in these 3 major product groups, all groups contributed substantially to sales. Meat and poultry (4.9 percent) and fruits (4.5 percent) were the only major product groups accounting for less than 5 percent of sales.

Gross margins (24.8 percent of department sales) also fluctuated widely among product groups. They ranged from 18.8 percent of sales for meat pies to 28.9 percent for fish. The margins within frozen drinks were 18.6 percent of sales for orange juice and 31.7 percent for all others. Little difference existed between the margins within either vegetables or potatoes.

Turnover for all product groups was measured in terms of weekly sales per square foot of display space. This amounted to $9.72 for the department, with the range from $5.25 for bakery to $19.64 for orange juice (table 3). Dinners, meat pies, and meat and poultry had sales per square foot of about $10.00 while the remaining groups ranged from $7.28 to $9.54. These wide variations pointed out the differences in turnover at the levels of space utilization in the study firm and indicated that space was not being allocated on the basis of turnover.

Though many factors--such as a product's susceptibility to impulse buying, local competition, special promotions, and traditional margin percentages--affect gross margins, some relationship should exist between turnover and margins.

Table 3.--Sales, margins, and turnover by product group, 8-week experimental test, 8 frozen food departments, New England, 1961

Product group	Sales	Gross margins	Sales per square foot of display space per week
	Percent	Percent	Dollars
Drinks	27.6	21.7	19.64
Orange juice	21.1	18.6	23.62
All others	6.5	31.7	6.73
Vegetables	15.4	24.4	7.28
Peas	2.7	22.9	7.79
All others	12.7	24.8	7.18
Dinners	9.9	26.6	12.43
Fish	8.0	28.9	8.16
Prepared foods	7.8	27.4	9.13
Potatoes	7.7	25.4	8.19
French fries	4.4	27.0	8.43
All others	3.3	23.2	7.88
Bakery	7.6	26.2	5.25
Meat pies	6.7	18.8	12.68
Meat and poultry	4.9	27.7	11.66
Fruits	4.4	27.1	9.54
Total department	100.0	24.8	9.72

For example, if the price-making process is reflecting savings from high turnover, a negative relationship would be expected between gross margins and turnover as measured by sales per square foot of display space. A simple correlation analysis between these two factors for the data reported in table 3 did indicate a statistically significant negative relationship. 5/ Thus, turnover, which accounted for about 38 percent of the variation in gross margins, did appear to be a major determinant in the price-making process.

5/ The correlation coefficient (-0.61) was significant at the 5-percent level of type I error.

RETURNS TO FIXED COSTS AND DISPLAY SPACE

Variable costs (3.7 percent for the department) had only a slight effect upon returns, since they were a small proportion of gross margins (table 4). Only the labor cost portion of variable costs fluctuated by product group since trading stamps remained constant at 2.0 percent of sales for all product groups. Labor cost (1.7 percent for the department) ranged from 1.2 percent of sales for fish to 3.0 percent for other potatoes. 6/ Returns to fixed costs as a percentage of product group sales are reported in table 4.

Returns per square foot ($2.12 for the department) varied substantially among product groups, ranging from $1.17 for bakery products to $3.61 for orange juice. These returns were high for dinners ($2.90) and for meat and poultry ($2.72) and were low for all other vegetables ($1.50), peas ($1.44), and all other potatoes ($1.43). These wide differences in performance indicated that margins and variable costs did not compensate for the huge differences in turnover among product groups. If these differences in returns to space are to be reduced, either the margin structure or allocation of space within the frozen food department must be drastically altered.

SPACE ALLOCATION RESULTS

Average turnover and returns ratios, however, are not the best guides to use in evaluating the effectiveness of space allotments. Instead, the marginal response (the change in sales or returns from a 1 square foot change in display space) is required. The marginal relationships for the total department and by product group were obtained through the controlled experimental test and its subsequent statistical analysis (see appendix for details).

Changes in space allocations had a significant positive effect upon sales for both the total department and all product groups. The response, however, varied between the high- and low-turnover groups of stores. 7/ For the total department, marginal sales per square foot were $5.43 for the high group and $2.49 for the low group (table 5). For example, a sales increase (decrease) of $5.43 is indicated for each square foot of display space added to (subtracted from) the frozen food department in the high-turnover group of stores. 8/

Marginal relationships by product groups were similar between the two groups of stores in most instances. The marginal sales per square foot were highest for orange juice in both turnover groups ($17.17 for the high and $13.65 for the low). Likewise, peas had the lowest sales per square foot ($2.60 for the high and $2.33 for the low group).

6/ The variable time requirements for each package size are reported in table 7.

7/ High-turnover stores had weekly sales per square foot of selling area over $4 while low-turnover stores had $3 - $4. For a description of the stores, see table 1, p. 3.

8/ The marginal ratios reported in this study hold only for relatively small changes in space allocations since they are linear approximations for the space levels tested in the experiment. The levels of display space by turnover group are reported in table 8.

Table 4.--Margins, labor cost, returns to fixed cost, and returns to space by product group, 8-week experimental test, 8 frozen food departments, New England, 1961

Product group	Gross margins	Labor cost 1/	Returns to fixed costs 2/	Returns per square foot of display space per week
	Percent	Percent	Percent	Dollars
Drinks:				
Orange juice	18.6	1.3	15.3	3.61
All other	31.7	1.9	27.8	1.87
Vegetables:				
Peas	22.9	2.4	18.5	1.44
All other	24.8	1.9	20.9	1.50
Dinners	26.6	1.3	23.3	2.90
Fish	28.9	1.2	25.7	2.10
Potatoes:				
French fries	27.0	2.2	22.8	1.92
All other	23.2	3.0	18.2	1.43
Bakery	26.2	2.0	22.2	1.17
Prepared foods	27.4	1.6	23.8	2.17
Meat pies	18.8	2.0	14.8	1.88
Meat and poultry	27.7	2.4	23.3	2.72
Fruits	27.1	1.4	23.7	2.26
Total department	24.8	1.7	21.8	2.12

1/ Based on wage rates of $2.13 per hour.
2/ Gross profit less variable costs of trading stamps (2.0 percent of sales) and labor cost.

Table 5.--Sales responses and marginal returns per week to space by product group, high- and low-turnover groups of stores, 8-week experimental test, 8 frozen food departments, New England, 1961

Product group	Sales per square foot of display space per week		Marginal as percent of average	Marginal returns per square foot	Sales per square foot of display space per week		Marginal as percent of average	Marginal returns per square foot
	Average	Marginal			Average	Marginal		
Drinks:								
Orange juice	26.82	17.17	64	2.63	20.82	13.65	66	2.09
All other	7.20	4.17	58	1.16	6.24	2.80	38	.78
Vegetables:								
Peas	10.41	2.60	25	.48	5.61	2.33	42	.43
All other	9.62	7.97	83	1.67	5.53	4.43	80	.93
Dinners	14.59	8.40	57	1.72	10.06	3.43	34	.80
Fish	10.15	4.90	48	1.26	6.54	2.41	37	.62
Prepared foods	10.83	5.29	49	1.26	7.53	3.36	45	.80
Potatoes:								
French fries	9.48	4.65	49	1.06	7.37	4.31	58	.98
All other	8.92	3.39	38	.62	6.87	3.44	50	.63
Bakery	6.88	5.78	84	1.28	4.79	3.42	71	.62
Meat pies	15.54	10.38	67	1.54	9.82	4.52	46	.67
Meat and poultry	14.41	5.37	37	1.25	8.81	3.35	38	.78
Fruits	12.38	9.13	74	2.16	7.24	3.56	49	.84
Total department:								
Display space	11.87	5.43	46	1.04	7.49	2.49	33	.53
Selling area 1/	3.20	1.47	--	.28	2.02	.67	--	.14

1/ Based on a ratio of 3.7 square feet of selling area per square foot of display space.

Marginal sales per square foot were about one and a half times greater for the high- than the low-turnover group. However, little difference in marginal sales per square foot existed between the high and low groups for potatoes and vegetables (table 5). Marginal sales per square foot were over twice as great for the high- as the low-turnover group for the total department, fruits, meat pies, dinners, and fish. In general, these product groups had high average sales per square foot.

No consistent relationship was present between average and marginal sales per square foot. For the high-turnover group, marginal sales per square foot were 84 percent of average sales per square foot for bakery products but only 25 percent for peas. In several instances, marginal sales per square foot indicated an entirely different relationship than average sales per square foot. For example, in the high group, peas had an average sales per square foot of $10.41 compared with $9.62 for other vegetables. Marginal sales per square foot, however, were over three times as much for other vegetables ($7.97) as for peas ($2.60). In this instance, using averages to allocate space would be a serious mistake. The same relationship between peas and other vegetables was also present in the low group. Bakery was another product group that would likely be shortchanged if average rather than marginal ratios are used to determine space allotments.

The wide discrepancies in marginal returns per square foot indicated the serious misallocation of space. Although orange juice was the largest seller, it deserved far more space than it received, while all other drinks, a low seller, received too much space. Fruits, meat, pies, and dinners especially need more space while both groups of potatoes should be reduced. Though other factors in addition to returns--such as variety, stocking ease, and the overall appearance of the department--must be considered, substantial improvements in space utilization would appear to be achievable.

Improvements in space allocation result in long-run savings in fixed costs. For example, fixed department costs (10.2 percent of sales) averaged about $7,500 per store on a yearly basis. Even a small saving in long-run costs, such as 10 percent, would amount to annual savings of $750 per store. 9/

Since the scope of this study was limited to the frozen food department, no comparisons of the returns between it and the other retail departments were possible. Interdepartmental comparisons are facilitated by converting sales and returns ratios from display space to sales area. In terms of square feet of selling area, marginal returns were 28 cents for the high group and 14 cents for the low group of stores (table 5).

9/ For a more detailed discussion of the space management aspects of this study, see: Crossed, Charles E. Display Allocation and Product Evaluation Routine: Frozen Foods in the Retail Store. A speech presented at 4th Food Distribution Research Conference, Michigan State University, East Lansing, Mich., Oct. 23, 1963.

APPENDIX

Data on economic cost were obtained from records of a New England chain for 1961. Since the firm bought its frozen foods from a wholesaler, gross margins included the costs of warehousing and transporting. Cash and promotional allowances were added to gross margin for the comparisons among products, but margins for individual product groups in the experimental test did not include these allowances.

The 8-week experimental test was conducted during the fall of 1961. Four treatments, each of 2 weeks' duration, were applied to 2 replicate latin squares of 4 stores each. The treatments consisted of changing the amount of display space from that normally allocated for both the total department and individual product groups as follows:

1. Increase 10 percent.
2. Increase 20 percent.
3. Decrease 10 percent.
4. Decrease 20 percent.

Changes in total space for the department were made by installing or removing display equipment or by changing the space allocation for ice cream, which was not included in the test. Sales for each treatment were obtained directly from invoices and a complete item inventory that was taken each time the treatments were changed. Elemental time-study data were also collected to determine the variable labor costs for each package size.

Treatment effects were not statistically significant for most of the product groups when tested with the conventional analysis of variance procedure, which partitioned the effects to stores, time periods, treatments, and experimental errors. Neither was the regression coefficient for sales on display space highly statistically significant for some of the product groups when tested with the analysis of covariance procedure that corrected for differences in intercept levels from square, store, and time-period effects. 10/ Both of these models made the false assumption that the relationship between sales and display space were additive, and thus no interaction was present between the two variates.

Stores were then grouped into those with total weekly sales per square foot of selling area over $3 and those between $2 and $3. These data were fitted with a stepwise computer program to a multiple linear regression model with sales as the dependent variable. Independent variables in the model consisted of: 11/

10/ For a general discussion of the analysis of variance and covariance models, see: Henderson, Peter L., et. al. Sales of Two Campaign Themes. In Quantitative Techniques in Marketing Analysis, pp. 204-219. R.D. Irwin, Homewood, Ill., 1962; and Henderson, P.L., et. al. Nonquantified Adjustment of Seasonality in Time Series Data. Jour. Ad. Res. 4(2): 38-44. June 1964.

11/ Suits, D.B. Use of Dummy Variable in Regression Equation. Jour. Amer. Statis. Assoc. 52: 548-555. Dec. 1955; and Johnson, J. Econometric Models, pp. 221-228. McGraw-Hill, New York, 1963.

1. A zero-one dummy variable for each store, time period, and turnover group to change the intercept level.

2. A real independent variable, the square feet of display space for all observations, to measure a common regression coefficient.

3. An interaction dummy variable for each turnover group to measure whether the slope of the group differed from the common regression line. The interaction term consisted of the square feet of display space for observations belonging to the turnover group and zero for those observations not belonging to the group.

The interaction terms for both turnover groups were statistically significant at less than the 0.05 level of type I error for all product groups (table 6). A common intercept level, however, was indicated for both groups. A substantial reduction in experimental error was obtained in most of the equations by correcting for differences in intercept levels (additive effects only) for those stores and time periods that were significant at the 0.05 level of type I error.

Table 6.--Regression coefficients and coefficients of determination (R^2) before and after correction for significant store and time-period effects by product group, 8-week experimental test, 8 frozen food departments

Product group	Intercept constant (weekly sales) $\hat{a}$	Sales per square foot 1/		Before correction R^2	After correction R^2
		High group $\hat{b}_h$	Low group $\hat{b}_l$		
	Dollars	Dollars	Dollars		
Orange juice	106.89	17.17	13.65	0.47	0.58
Other drinks	14.89	4.17	2.80	.20	.90
Fruits	21.22	9.13	3.56	.35	.73
Peas	26.34	2.60	2.33	.29	.90
Other vegetables	11.43	7.97	4.43	.36	.59
French fries	26.99	4.65	4.31	.37	.54
Other potatoes	28.43	2/ 3.39	3.44	.30	.42
Meat pies	35.48	10.38	4.52	.44	.74
Meat and poultry	39.38	5.37	2/ 3.35	.34	.72
Dinners	65.08	8.40	2/ 3.43	.30	.74
Fish	65.52	4.90	2.41	.61	.81
Bakery	20.26	5.78	3.42	.46	.52
Prepared foods	56.82	5.29	3.36	.53	.71
Total department	836.05	5.43	2.49	.73	.85

1/ All coefficients were significant at the 0.01 level of type I error unless otherwise noted.
2/ Significant at the 0.05 level of type I error.

Table 8.--Average display space for high- and low-turnover group, by product group, 8-week experimental test, 8 frozen food departments, New England, 1961

Product group	Display space			
	High-turnover group		Low-turnover group	
	Area	Percentage of department space	Area	Percentage of department space
	Sq. ft.		Sq. ft.	
Orange juice	13.6	9.5	12.5	7.8
Other drinks	14.7	10.3	13.8	8.6
Fruits	6.1	4.3	7.8	4.9
Peas	4.6	3.2	5.8	3.6
Other vegetables	21.0	14.8	30.8	19.2
French fries	7.7	5.4	7.7	4.8
Other potatoes	6.0	4.2	6.2	3.9
Meat pies	7.7	5.4	7.7	4.8
Meat and poultry	6.3	4.4	6.1	3.8
Dinners	11.9	8.3	11.9	7.4
Fish	13.0	9.1	15.9	9.9
Bakery	17.9	12.5	21.1	13.2
Prepared foods	12.3	8.6	13.0	8.1
Total	142.8	100.0	160.3	100.0

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Table 7.--Time requirements for pricing and stocking frozen food packages (variable elements only), 8 frozen food departments, New England, 1962

Commodity	Handling time per case
	Hours
12 pack:	
Poly bags	0.048
Pizza	.046
Meat with price per pound label	.085
All other	.038
48 pack cans:	
6 pack	.038
Dump display	.038
No price mark	.046
Dump/no price	.030
All others	.064
24 pack:	
Cans	.048
Meat with price per pound label	.092
Poly bags	.064
All other	.048
6 pack:	
Bakery	.041